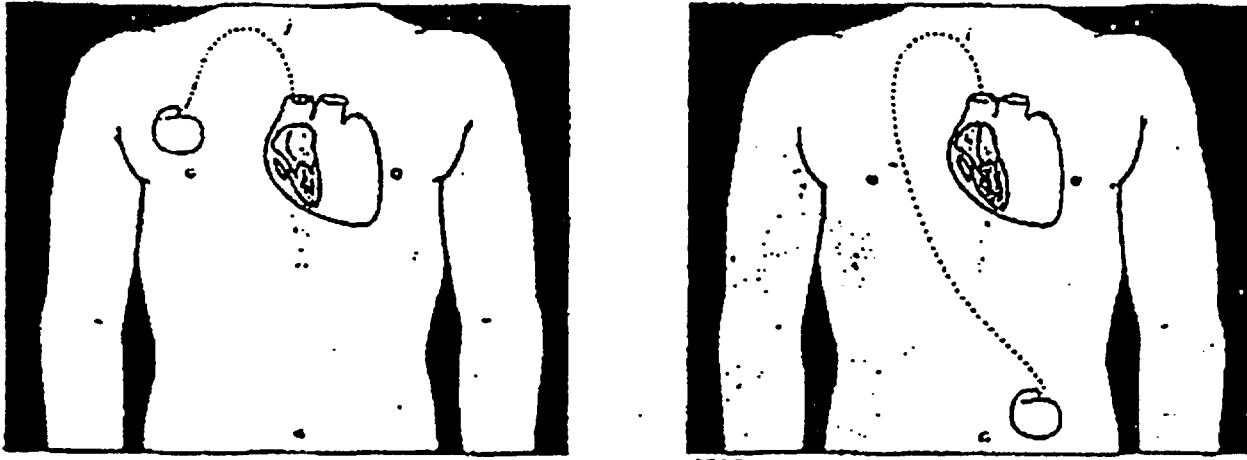


## Measurements on pacemakers



### Test conditions

- Monitoring over electrodes on arms and legs
- Monitoring of stored data in pacemaker
- Switch telephone on
- Normal operating conditions (Bi-/Unipolar)
  - Scan over pacemaker
  - Scan over heart
  - Scan over whole thorax
- Maximum sensitivity
  - Scan over .....
- Repeat with 4 different mobile phones

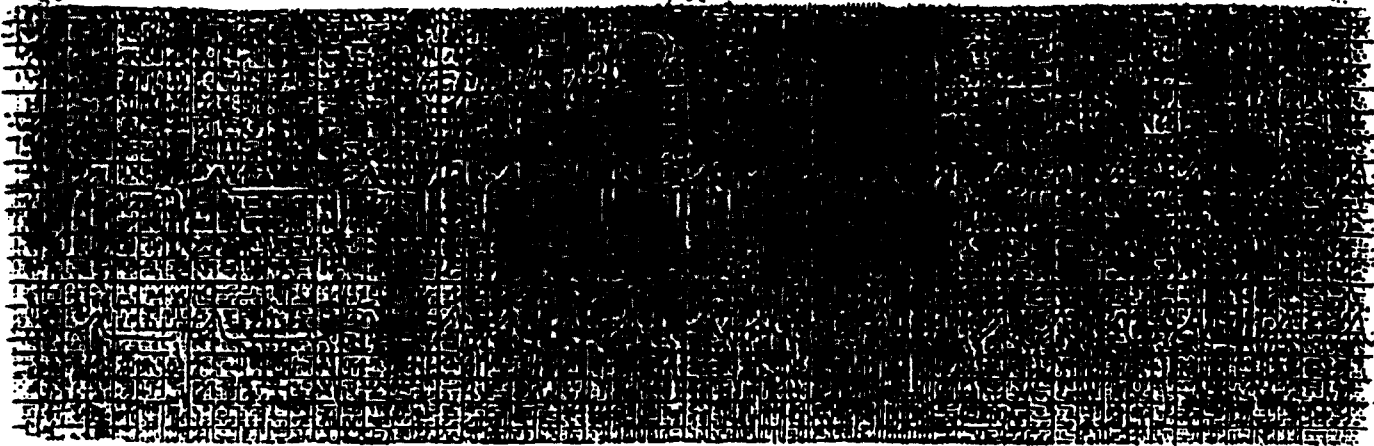
## Test results

### **Implanted pacemakers:**

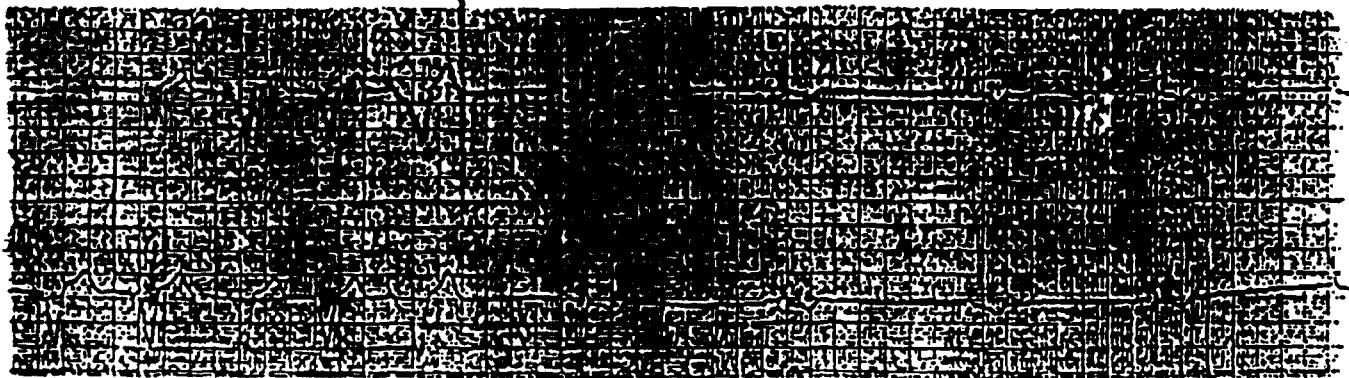
- No interference found in "normal telephone operation"
- Interference on 7 out of 38 pacemakers found when hand held phone placed directly over the implanted pacemaker (inhibition, speed-up). Portable phones within 1 - 2 cm.
- In DTX-mode, interference from hand-helds 1 - 2 cm over pacemaker. Portable: approx. 10 cm.
- No interference by coupling at the stimulation leads of the pacemaker.
- No irreversible interference caused on the pacemakers

### **Non-implanted Pacemakers:**

- In DTX mode: Interference levels reduced to approx. 1/3 of the electrical field strength values found for interference in normal mode



Effects found: Speed-up (phone placed over implanted pacemaker at vertical trace)



Effects found: Inhibition (phone placed over implanted pacemaker at vertical trace)

## Conclusions

- Use of TDMA-modulated mobile phones not recommended with implanted pacemakers (provisorial)
- Interference due to near-by use of mobile phones not likely
- Precautions for the use of mobile phones inside a car

# **HEAR-IT NOW**

*Helping Equalize Access Rights In Telecommunications Now*

1050 Connecticut Avenue, N.W.

Suite 1100

Washington, D.C. 20036

## **SUMMARY OF ROYAL NATIONAL INSTITUTE FOR DEAF PEOPLE FACTSHEET**

- o "No hearing aid can be used with a hand-held digital [GSM] mobile telephone" [page 1].
- o "Unfortunately, it seems that there will be no cheap way to make existing hearing aids more immune [from GSM interference]" [page 4].



THE ROYAL NATIONAL INSTITUTE FOR DEAF PEOPLE

## **FACTSHEET**

### **NEW MOBILE TELEPHONES**

A number of new mobile telephones have come on to the market recently. They use digital techniques which can cause interference to hearing aids. The interference is a buzzing sound, which may be anything from negligible to extremely painful. The amount of interference depends on the design of the hearing aid, the power of the mobile telephone and the distance between the hearing aid and the telephone.

#### **How big a problem is the interference?**

Hearing aids will pick up interference from these new mobile telephones when they are being used by other people nearby. Although someone with a hearing aid may not find him or herself near a mobile phone user very often, the interference can be very annoying or uncomfortable when it does happen, particularly if it is difficult to move away (in a restaurant, for example).

At present no hearing aid can be used with a hand-held digital mobile telephone. The interference occurs whether your hearing aid switch is at the T position or the M position. What is more, none of these phones are fitted with an inductive coupler, the adaptation which makes it easier for you to use your hearing aid with the telephone.

#### **If you are thinking of buying a mobile telephone**

All hand-held digital mobile telephones cause severe interference to all hearing aids when the telephone handset is placed close to the hearing aid.

Analogue mobile telephones (from Cellnet and Vodafone) do not cause this interference. However, there are no hearing aid-compatible mobile

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telephones (either analogue or digital) so the hearing aid can not be used with the switch on the T position. This means that behind-the-ear hearing aids will not pick up the sound well from any mobile telephone.

You should only consider buying an analogue mobile telephone if you have an in-the-ear or canal aid. If you are buying a mobile telephone to use with your hearing aid, it is important to test the telephone while you are wearing the hearing aid. By doing this, you can make sure that the telephone does not cause any interference.

### **When can interference occur?**

Some hearing aids are more affected than others - it depends on the model. A mobile telephone being used by the driver of a passing car can cause noticeable interference. So can a hand-held mobile phone which is being used by someone sitting near you. But there should be no noticeable interference to any hearing aid, from even the most powerful mobile telephone, when they are more than three metres apart.

### **Do all hearing aids pick up the interference?**

Yes. At present, no hearing aid has been found that does not pick up this interference when the mobile telephone transmitter is near the hearing aid. So no hand-held digital mobile telephone can be used with any hearing aid. However, not all hearing aids will pick up interference if they are at least one metre away from the mobile phone.

### **What is being done about it?**

A special panel of the British Standards Institution (BSI) is urgently looking into this problem. On the panel are representatives from the RNID, Hearing Concern, hearing aid manufacturers, mobile telephone operators, the Department of Health, and other experts. The panel is creating a measurement standard, so that it will be possible to gauge the immunity of hearing aids to the interference. The standard will then be passed to European and International standards organisations.



The European Hearing Instruments Manufacturers Association is investigating how to measure this interference, and how best to design hearing aids that are more immune to it. Similar work is going on in Australia. These groups are contributing their findings to the BSI panel.

### **Which mobile telephones are digital?**

Mobile telephone operators are using various labels to describe their new digital mobile telephones. The systems vary in power, radio frequency and type of use, but all operate on basically the same digital principle. These are some of the trademarks and acronyms:

One-2-One  
Orange  
EuroDigital  
MetroDigital

TDMA  
GSM  
PCN  
DCS-1800

CT-2  
DECT

There may be others.

### **What about cordless telephones?**

Cordless digital telephones will be available soon. These work on the same principle, but at a low power. It is possible that they may cause interference when held close to a hearing aid, so again, try them with your hearing aid before you buy one.

### **Can my hearing aid be modified to not pick up the interference?**

No. Hearing aids are too intricate and there is no space for modifications. Hearing aid manufacturers are investigating how to design new hearing aids that are more immune to the interference.

## **Technical background**

Conventional mobile telephones use analogue technology, with just one conversation on each radio frequency at a time. As there are a limited number of radio frequencies available, this means demand is greater than supply, which keeps the cost high.

Digital systems work differently. They squeeze up to eight conversations on to each radio frequency, without the different conversations being aware of each other. This is done by TDMA - Time Division Multiple Access. In the case of GSM (Global System for Mobile communications), the radio frequency is divided up into eight time slots of 0.5 milliseconds (ms) each, repeating every 5 ms. When you are using the mobile telephone, every 5 ms of speech is digitally coded and sent out as a 0.5 ms burst of radio signal. These bursts, at a rate of 214 per second, are picked up by the wiring in the hearing aid, detected by any non-linearity in the circuit, and then amplified. The interference consists of a 214 Hz buzz plus harmonics. In some hearing aids, even turning down the volume control has no effect.

It is the unusual type of radio signal that causes the interference. Before this type of signal existed, radio frequency interference was not a problem for hearing aid designers. Several suggestions for improving the design of hearing aids to make them less susceptible are being investigated by hearing aid manufacturers. Unfortunately, it seems that there will be no cheap way to make existing hearing aids more immune.

Hearing aids do not last forever, and it is hoped that new hearing aids will be less affected by interference. Several organisations, including hearing aid manufacturers, are investigating the problem, and hearing aid manufacturers are working towards designing hearing aids that pick up less of the interference. That is why it is important to have a standard way of measuring the immunity of the hearing aids. This standard is being developed as quickly as possible so it will be possible to compare hearing aids, and hearing aid purchasers will be able to buy hearing aids with high immunity.

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## WHAT IS A HEARING AID?

A hearing aid is a miniature amplification system which delivers speech, music and other sounds to its wearer. In America, some four million hard of hearing people wear hearing aids. A hearing aid will not restore normal hearing, but it can increase sound in particular frequencies.

While hearing aids vary as to power output and augmentation of specific frequencies, all hearing aids contain the same basic components. These are a microphone, which picks up sound waves and converts them into electrical energy; an amplifier, which increases the strength of the electrical signal, thereby making the sound louder; a receiver or speaker, which converts the electrical signal to sound energy; the battery, which powers the hearing aid; and an earmold, to channel sound into the ear. Hearing aids also have controls, including an off/on switch and a volume control. Many hearing aids also have a "T-switch" which allows the aids to be used with telephones or assistive listening devices.

An individual will choose a hearing aid based on a number of factors, including the type of hearing loss experienced, the level of power necessary for sound amplification, physical factors and lifestyle. Four general types of hearing aids are available:

- The **canal aid**, which is fitted into the ear canal. It is of particular help for mild or moderate hearing loss. Because it is fitted in the ear canal, this type of hearing aid is almost unnoticeable.
- The **in-the-ear aid**, which fits into the outer ear bowl. This type of aid is also good for individuals with mild to moderate hearing loss. Canal and in-the-ear aids are the most popular hearing aids in the United States.
- The **behind-the-ear aid**, in which the components are contained in a plastic case worn behind the ear. This aid is helpful for mild to profound hearing loss.
- The **body aid**, in which the components are contained in a small case worn on the body and connected to the ear by a cord. A body aid is generally used by an individual with very profound hearing loss.

The cost of a hearing aid can vary dramatically, from a few hundred dollars to several thousand dollars for certain models. The "average" hearing aid is reported to cost approximately six hundred dollars.

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## **WHAT IS PCS?**

Personal Communications Services, or PCS, will be a primary entrance to the Information Superhighway. PCS will allow the transmission of voice, video and data through wireless technologies. As a result, PCS subscribers will be able to carry a small communications device that will link them to rural and urban areas across the country and around the world.

The Federal Communications Commission recently held an auction for 99 available PCS licenses. These licenses, which cover the country's largest cities, sold for over \$ 7.7 billion. It is expected that the deployment of PCS will begin by early in 1996.

The FCC does not require PCS devices to be hearing aid-compatible, as are current "wireline" telephones. HEAR-IT NOW has filed a petition with the FCC asking the agency to adopt rules mandating hearing aid compatibility, so that the country's four million hard of hearing individuals who wear hearing aids can enjoy the benefits of this exciting new technology.

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## **FCC CHAIRMAN CITES HEAR-IT NOW PETITION IN SPEECH**

In a speech to the annual convention of Telecommunications for the Deaf, Federal Communications Commission Chairman Reed E. Hundt expressed his views regarding wireless telephone compatibility with hearing aids.

"We are concerned about making wireless telephones hearing aid compatible," stated Hundt. "On June 15, we put the HEAR-IT NOW petition on wireless phone compatibility on public notice. We will examine the wireless telephone exemption seriously and swiftly." Chairman Hundt then requested that formal comments on the petition be filed with the FCC.

Additionally, the Chairman shared his personal "top ten" wish list of things the FCC might do to make equal access a reality. Number two on his list was to "ensure that cellular and PCS equipment were hearing aid compatible."

The complete text of the speech is attached.

CHAIRMAN REED E. HUNT  
FEDERAL COMMUNICATIONS COMMISSION

KEYNOTE ADDRESS

FOR THE

ELEVENTH INTERNATIONAL TELECOMMUNICATIONS  
FOR THE DEAF INCORPORATED (TDI) CONVENTION

Cambridge, Massachusetts

June 28, 1995

Hello. I'm happy to meet with you today. Thank you for inviting me to your conference.

A special thank you to Al ["Sonny"] Sonnenstrahl for inviting me to your "T" party.

It is a great honor to be the chairman of the Federal Communications Commission. I seriously consider it to be the single best job in the federal government that you don't have to get elected to.

It is great fun as well as a high honor to be chairman of the FCC at the time that the communications revolution is carrying the country into the information age.

What is even more important, however, is that the chairman of the FCC is entitled to pick one commissioner to be in charge of all our issues related to people with disabilities.

As you well know, Alexander Graham Bell had the skills and opportunity to invent the telephone because of his particular profession.

He was a teacher of the deaf.

So since I have the same birthday as Mr. Bell, I thought I should pick myself as the commissioner with special responsibility to handle our issues that relate to people with disabilities. While I can not invent like Mr. Bell could, I can do my best to make sure others' inventions are accessible to the broadest range of Americans.

At the FCC, we do two things: we help set fair

rules of competition and we serve the public interest.

We have jurisdiction over all lanes of the information highway: wire, wireless, satellite, cable, and broadcast TV and radio. We write the rules of competition for the businesses that are leading our economy into the 21st century.

If we get these rules right, we can help create millions of new jobs, tens of billions of dollars of economic growth, a more productive economy.

If we can stake a claim for the public in cyberspace, we can make our country not just richer, but better, we can provide new education tools for our children. We can give them the information highway in every classroom in the country.

But we have no higher responsibility and no greater calling than making sure that people with disabilities share in the communications revolution.

This mission is in itself a sufficient justification for the existence of the Federal Communications Commission.

You may have read that the new majority in the Congress has attracted some so-called "think tanks" to the communications field. Some include certain highly paid experts who recently announced to the world that the FCC should be closed down. The entire communications revolution, they said, would continue more quickly if the public interest in communications policy had no advocate at the FCC or anywhere else in government. They say, let the free market roll on unimpeded.

But with 20 years of legal practice in antitrust and communications, I can tell you from personal knowledge and experience that markets don't always work efficiently. Without occasional intervention by means of fair rule-writing, and even when they do maximize wealth, markets don't necessarily deliver the social benefits we all want from the communications revolution. The primary problem is this: when we say we want consumer demand to drive the building of the information superhighway, we are saying that the people with the most money to spend will determine what communications technology is developed and where it is delivered.

But why shouldn't people who aren't rich enough to

buy new communications technology also have a voice in the information age.

Some say that the communications sector ought to be just like the computer industry: essentially unaltered by government rules and unheeding of any claim by the public interest.

What a bad idea.

I have enormous respect for the accomplishments of our computer industry.

I am the first chairman of the FCC to have a computer on his desk. I am the first ever to send an e-mail. I have happily presided over the networking of the agency and the creation of our beautiful new site on the Internet. Our World Wide Web address, by the way, is "www.fcc.gov". Look us up anytime. E-mail me at "rhundt@fcc.gov".

But do I want our communications sector, including telephones, broadcast, and cable, to be like today's computer industry?

Not hardly.

After all, computers are in only one-third of the homes in the country. The rest of the country lacks the money to buy, or the training to run the darn things.

On the other hand, telephone service reaches 94% of the country and free TV is available to 99% of our homes. This is due, in large part, to the FCC and its policies of universal service.

So if we don't continue in this country to ask the FCC to maintain a policy of universal service and affordable access, we can be assured that the wonders of the communications revolution will, like personal computers, be available to only some Americans.

This revolution will be seized by the few and closed off to the many.

And we can be assured that most people with disabilities would be left out of the communications revolution. The reason, as I am sure you know, is that people with disabilities tend to earn less money than people without disabilities. According to the Harris survey, almost 60% of households headed by persons with disabilities have incomes of \$25,000 or less.



If we rely solely on market forces to drive the communications revolution, then people with disabilities will be disenfranchised in the communications revolution. Americans with disabilities then would be denied the basic tools necessary in the Information Age to get an education, to get a job, to share in our cultural experience, to be part of politics, to communicate.

The American dream is that life, liberty and the pursuit of happiness is guaranteed for all Americans. It would be the American nightmare if these rights were available only for some of us. The American dream is a beacon of hope for the world because we dream it together for the benefit of all of us. We would live an American nightmare if each of us were condemned to hope and strive only for our own individual betterment.

So we say the FCC should be the Fair Communication for Everyone in the Country Commission: the FCECC.

That name is consistent with our historic mission. The Commission has been given special tasks under the Hearing Aid Compatibility Act of 1988, the Television Decoder Circuitry Act of 1990, the Rehabilitation Act of 1973 and the Americans With Disabilities Act of 1990.

*We're proud of* these missions.

And we're proud of the new jobs that the Senate telecommunications reform bill would give us. The bill requires telecommunications equipment manufacturers and service providers to ensure accessibility by individuals with disabilities, if readily achievable. The FCC is given the responsibility of making rules to reach this goal. Now let's review some recent FCC accomplishments.

By June 15, an FCC advisory committee proposed a new set of rules that would dramatically increase access by persons with hearing disabilities to wire telephones. Under the recommended rules, all wireline telephones in the workplace, in confined settings, (such as hospitals and nursing homes), and in hotels and motels eventually will be hearing aid compatible. Since 1989, many people with hearing disabilities and industry groups were deadlocked over how to solve the HAC problem. At last, we have a working basis for a solution.

The FCC now will shortly submit these proposed rules for public comment in a Notice of Proposed

Rulemaking. Your comments on these proposals will be welcome.

We are also concerned about making wireless telephones hearing aid compatible. On June 15, we put the Hear-It Now petition on wireless phone compatibility on public notice. We will examine the wireless telephone exemption seriously and swiftly. We need your comments.

In addition: (1) The Commission's policies have helped create standards for a nationwide telecommunications relay service, or TRS. We project over 150 million minutes of TRS use in 1995.

In an order released just this month, we held that optional discount calling plans must be made available to TRS users on an equal basis with non-TRS users. We also said that TRS users cannot be charged more for directory assistance services.

In addition, we want to make payphones accessible to TRS users, through such devices as special calling cards and free local calling.

(2) The FCC has required that all televisions in the U.S. be equipped with decoder circuitry for closed captioning.

(3) The FCC assigned frequencies to be used for assistive listening devices. We propose to create a new low power radio service which will make additional frequencies available for this purpose.

(4) And we have ruled that computers with monitors 13 inches or larger must be able to display the closed captions transmitted by television signals.

Everyone says Silicon Valley is going to invent the telecomputer that will fuse TVs and PCs. If this is so, we are going to guarantee that this wonderful new invention works for people with disabilities.

To tie all our efforts together, I have formed a Disabilities Issues Task Force, with representatives from every FCC office and bureau. Since its inception three months ago, the Task Force has received presentations from folks at Independent Living Centers and from technical experts in ADA enforcement. A few weeks ago, they visited an industry-sponsored center to learn more about technology to assist people with disabilities.

The acting head of the Task Force is Karen Brinkman; you should feel free to contact her. Just e-mail "kbrinkma@fcc.gov".

Finally, I'd like to share with you my personal "top ten" list -- a wish list of ten things that the FCC might do to make equal access a reality. These are not jokes like David Letterman's top ten list but I'd like them to become just as well known. I frankly don't know if all these things are feasible or practical; but with your help I suggest we find out.

Number ten. Hold an "Access 2000" summit with persons with disabilities, industry, and government rulemakers to develop an agenda for action for the next 5 years.

Number nine. Ensure that all televised Commission meetings and publicly sponsored Commission events are closed captioned, and provide all Commission publications over the Internet so they can be downloaded in alternative formats, such as braille, enlarged text, and audio text.

Number eight. Require permanent labeling on all hearing aid compatible communications equipment.

Number seven. Review all the Commission's rules to ensure that advances in network services are accessible to and usable by persons with disabilities.

Number six. Explore assignment of N11 codes for TRS access.

Number five. Consider assigning permanent, exclusive frequencies for assistive listening devices.

Number four. Require volume control on all telephones.

Number three. Expand mandatory minimum TRS program standards by:

- (a) requiring CAs (communication assistants) to relay in specifically requested foreign languages;
- (b) requiring TTY and Telebraille equipment distribution programs;
- (c) requiring operator services to access TTY numbers; and
- (d) requiring audiotext capability.

Number two. Ensure that cellular and PCS

equipment are hearing aid compatible.

And number one. Determine how to get closed captioning for all television and cable programming.

And since it is your 11th international convention, I hope you will permit me to add an 11th wish. I would like to see all the classrooms in America connected to the information highway. This, more than anything else, will ensure the opportunities of the communications revolution are available to all. Link each classroom to the information highway and you link each child, each family, each community.

Networked classrooms can teach kids job skills, certainly. But especially for children with disabilities, this link is an invaluable way to explore new worlds. Technology can also help them to learn the basics by allowing for something that even the best teachers can't always provide -- it can accommodate their disabilities on an individual level. It can also offer them chances to work more independently, it can increase their self-esteem. It can even give them reasons to learn by linking them across geographic lines to other children -- some who have similar disabilities and others who may simply share a desire for an e-mail penpal. Computers now feature synthetic speech, voice activation, breath activation, virtual reality, and visual icons. All children with disabilities can and should share in all of these promising inventions of the information age. No one thinks Mr. Bell's telephone should have been made available only to those with big bucks. No one should welcome the prospect that the communications inventions of the next century will be available only to the few and not the many of the information age.

But we are not going to get a chance to make any of these eleven items a reality if the FCC is going out of existence.

When some of the most powerful leaders in Congress say that the FCC should wither away in a few years, they should understand that they are sending a message that the country should do nothing to include people with disabilities in the communications revolution.

Is this what they mean? I hope not.

By the way, I mentioned that I share a March 3 birthday with Alexander Graham Bell. What is really important about March 3 is that it happens to be the birthday of my six-year old daughter Sara.

Her future, and this country's future, depend on how we answer the question before us: Whether the communications revolution will benefit all Americans. So: is that what we want or not? And if we want everyone to benefit, are we willing to take the many practical, important, real steps that will make it so.

I'd like my daughter and all other six-year-olds to know that we in this room will devote ourselves to making sure the right answers to these questions are the winning answers.

As we celebrate the fifth anniversary of the ADA next month on July 26, let us renew our commitment to realizing its principle. And let us work together to achieve solutions that will make all our children proud of all of us.

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**The following articles contain information about GSM interference to hearing aids, as well as other medical and consumer electronics devices.**

Australia: Austel Urged to Regulate Digital Phones for Deaf, The Age (Melbourne), June 22, 1993.

Controversy Fares Up Over Interference from European GSM Cellular Telephones, Electronic Design, August 19, 1993, p. 35.

Deafening Response, Daily Telegraph, April 19, 1993, p. 32.

Falling to Bits?, The Economist, May 29, 1993, p. 89.

GSM Interference, Asia Telecom Daily, May 18, 1993, p. 1.

GSM Interference "Solutions" Criticized by UK Deaf Lobby, Exchange, September 17, 1993.

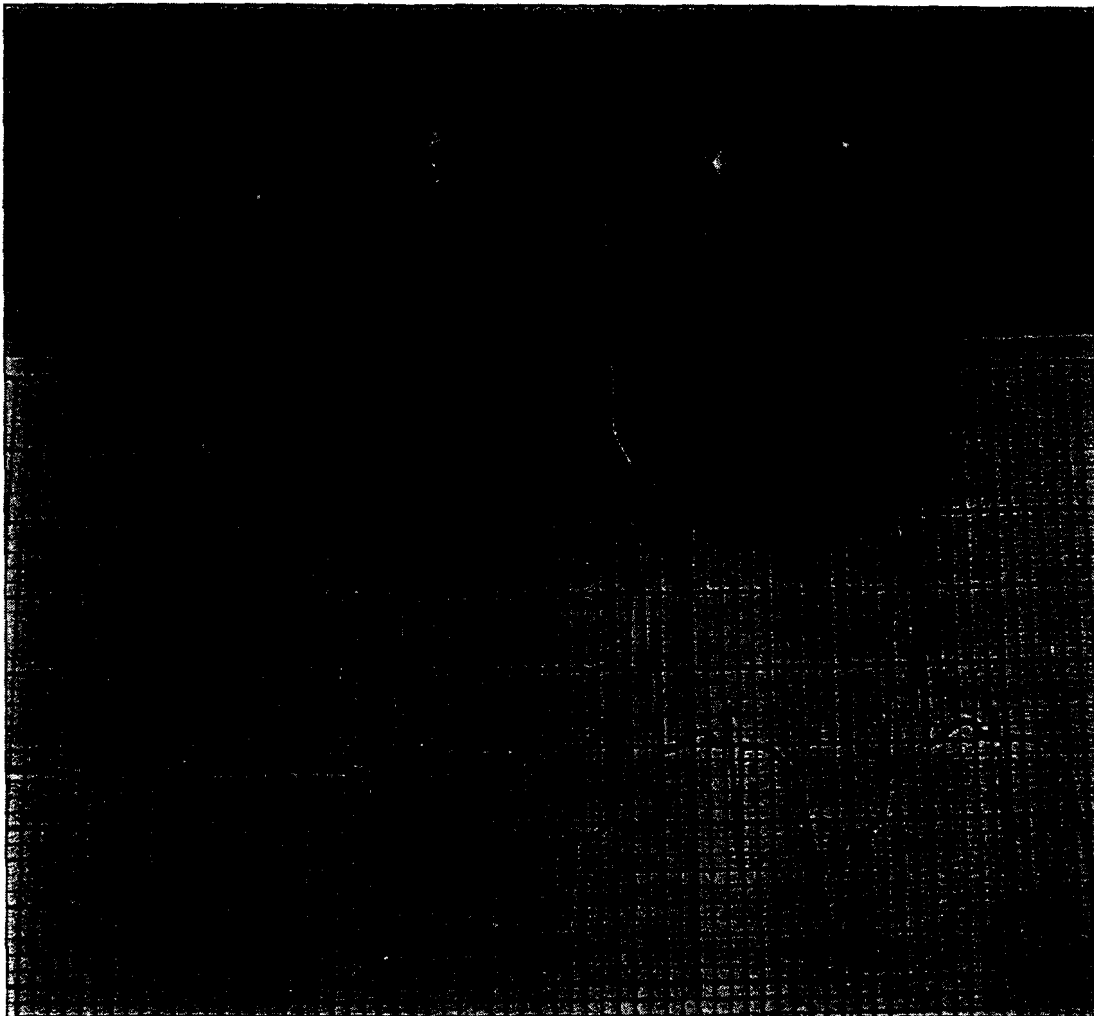
Grand Scale Mistake?, Australian Communications, July 1993, p. 13.

Interfering with Hearing, Mobile Europe, July 1992.

Pain Fears Over New Mobile Phones, Financial Times, April 5, 1993, p. 6.

UK: Claim that Mobile Phones Inflate Car Airbags to be Examined, Computer Weekly, August 12, 1993.

Watt's the Buzz About Electrics Laws?, The Scotsman, Jan. 26, 1995, p. 26.



Left:  
Tests show mobiles will  
not interfere with pace-  
makers.

# COMPATIBILITY IS THE KEY

**M**obile telecoms can be a life-saver in a number of ways, from co-ordinating the emergency services to the pager summoning a doctor to a heart attack victim's bedside. But without electromagnetic compatibility (EMC)- the ability of different equipment to work simultaneously without causing interference - mobile comms could constitute a health hazard.

In those cases where interference occurs it is not the mobile phone's fault; it is performing as it should by

**COMPATIBILITY IS NOT ONLY USEFUL IN RELATIONSHIPS. THE SIGNALS FROM A MOBILE PHONE ANTENNA COULD PLAY HAVOC WITH PACEMAKERS AND HEARING AIDS, OR SEND CAR ALARMS HAYWIRE - AS SVEN HUBERMARK EXPLAINS.**

transmitting a radio signal, it is the electrical equipment which is misbehaving by working like a radio receiver.

EMC is not a new phenomenon,

though the increase in mobile comms in general and pocket handsets in particular, have heightened awareness. The closer you, or a piece of equipment, is to the transmitting antenna,

Below:  
Luckily, nobody was  
injured when GSM's  
phone caused an airbag  
to inflate in Belgium.



**Right:**  
There is concern about signals interfering with insulin pumps.

the stronger the signal.

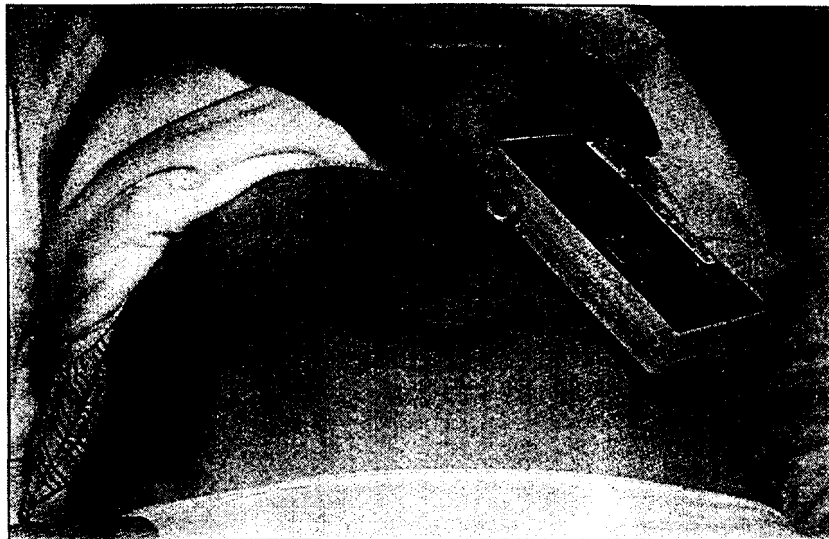
Tests for assessing EMC can be carried out by exposing electronic equipment to radio signal radiation. These trials are performed across a wide frequency range with radiation intensity dependent on which test norms are used. The most common norm is 3V/m, and in extreme cases up to 10V/m, especially for vehicles and hospital equipment.

Maximum peak power for GSM is 2W, and half that for NMT, the Scandinavian analogue standard for cellular phones, although the level of power is limited by the base station to the amount needed.

As early as the '60s, the substitution of transistors for valves in home electronics caused some interference with amplifiers, a problem the manufacturers resolved in due course.

More recently, NMT analogue systems send out signals throughout a conversation, while the new GSM digital standard incorporating 'time-sharing', involves up to eight calls on the same channel, being sent out in bursts. The signals are divided and sent out at a rate of 217 per second.

Both these technologies can cause problems, hence the extreme precautions insisted on for their use in hospitals and on aircraft. In order to be 100% sure interference will not occur, all manner of radio wave generators have to be tested in every possible location, which is obviously impractical when it comes to hospitals and planes where new equipment is con-



stantly being developed and installed. Hence the restrictions on mobile phone use.

In fact, any piece of equipment containing electrical components can be affected by radio waves. Interference can be particularly noticeable in equipment with sound amps like radios, TVs, CD players, walkmen, hearing aids and telephones. Now that they are becoming computerised, vacuum cleaners and cookers are also susceptible. Car ignitions and burglar alarms can be affected, as can pps.

On a more serious note, pacemakers and insulin pumps could be liable to interference. However, modern pacemakers are designed to handle field strengths over 40V/m and when they are operating within the body the radio waves are further attenuated. So those with pacemakers can use pocket phones safely.

Hearing aids worn externally can

be troubled by interference at between 0.7 and 3V/m. When worn internally the field can be up to 5-3V/m. Manufacturers are still to find a total solution to this problem.

Tests involving insulin pumps showed there was interference at a field strength of 6W on 900MHz at five centimetres, an unsatisfactory situation.

## RULES AND REGULATIONS

European directive 89/336 states that equipment used by consumers domestically should be able to tolerate 3V/m, which means that there is little likelihood of interference as long as the mobile handset is two to three metres away from the piece of equipment.

There is little evidence that mobile phones interfere with PCs, although connecting a handset to a PC could cause 'wirebound radiation' and the PC supplier's instructions should, therefore, be strictly adhered to.

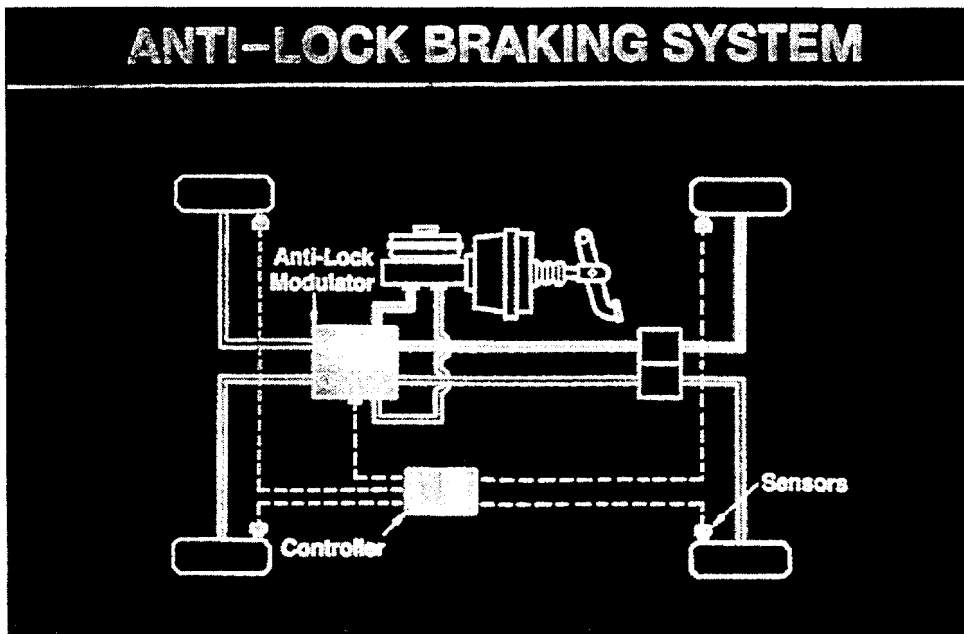
Car producers test models with field strengths of 10V/m and any extra equipment should only be fitted by an expert and tested to avoid problems. Mobile phone antennas should always be fitted on the car roof.

There has been one reported case of an airbag being triggered by a GSM phone in Belgium; fortunately nobody was injured and there is concern about electronic anti-lock braking systems.

As work on international standards continues, EMC regulations are being formulated and improved. There are a number of institutions dealing with the topic in depth. In Sweden alone there are three large organisations testing to EU regulations.

Increased awareness about the potential problems caused by the proliferation of mobile comms must be matched with measures to ensure EMC.

**Below:**  
Anti-lock braking systems are another potential problem.







Bill Machrone

## Portable Telephones for Everyone

America's telecommunications industry is teetering on the brink. The FCC has auctioned off billions of dollars' worth of radio spectrum for the industry to offer new wireless services, called PCS (personal communications services). The winners must

now choose the technologies they will use and begin to build the infrastructure of transmitters, switches, and consumer devices. Whatever technology they choose, the system will be digital, with significantly better capacity, compatibility, and privacy.

Europe has had such a system in place for several years. The European standard, GSM, is technologically advanced but for one small problem: It can't be used by hearing-aid wearers. In fact, if hearing-aid wearers come within several feet of a GSM phone, they hear a loud buzzing. If they get closer, the buzz becomes deafening, drowning out even the sound of their own voices.

The problem is well known in Europe. With billions of dollars' worth of infrastructure in place, however, it's too late to change the technology. Modifying the hearing aids isn't a viable solution, either. With the emphasis on small size, light weight, and long battery life, there's virtually no hope for improving the installed base. Even with new hearing aids, the problem cannot be eliminated.

Tragically, hearing aids didn't have to be a problem. GSM is based on a time-division multiple access (TDMA) scheme that causes the cellular phone to send out a pulse of radio-frequency energy 217 times per second. That's what the hearing-aid wearers hear. If the system had been built with another technology, such as CDMA (a lower-power, spread-spectrum technology), or at nonaudible frequencies, the interference would have been greatly reduced.

The chairman of GSM MoU, the oversight group for GSM vendors, has written to FCC chairman Reed Hundt to address the concerns: "Some of the research suggests that a small percentage of all hearing-impaired persons use old, inferior-quality hearing aids, and therefore may be unable to use high-power

digital wireless telephones, whether they be CDMA, GSM, or AMPS-D." The letter suggests that existing hearing aids can be upgraded or replaced but doesn't address the attendant cost issues.

Given what we know about the potential effect of GSM on more than 6 million U.S. hearing-aid wearers, it's unconscionable to pursue this option. Yet BellSouth and Pacific Bell have decided to deploy GSM.

GSM has other problems, too. The power level, combined with the fast rise time of pulses, reportedly causes problems with electronic devices. Sweden bans the phones from its hospitals because they reportedly interfere with pacemakers and electric wheelchairs. A report from an Australian newspaper claims that a GSM car phone set off the car's airbag. One potential plus: GSM phones are said to be able to reset a Parisian taxi meter to zero.

GSM may be a poor choice for mobile computing. I wonder about the potential for confusing the sensitive innards of notebooks or interfering with emergency communications equipment.

American telephone companies are not without alternatives to GSM. NA-TDMA runs at lower power and is tailored to North America. CDMA has been slow in emerging

from the lab but should be far better for the mixed voice and data services critical to mobile executives.

These technology decisions are irrevocable once the building begins. Cellular phones have always been incompatible with hearing aids; let's not do the deaf another disservice. If you're not concerned about the plight of the hearing-impaired, look at your own situation with enlightened self-interest. If you believe that GSM is not the right choice, let the FCC know (Federal Communications Commission, 1919 M St. NW, #814, Washington, DC 20554). □



*PCS telephones will be terrific—as long as you're not hearing-impaired.*